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INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

To:

RAFFNSOE ,K.  
INTERNATIONALT PATENT-BUREAU  
23 Hoje Taastrup Boulevard  
2630 Taastrup  
DANEMARKDate of mailing  
(day/month/year)

18.05.00

Applicant's or agent's file reference  
IPB/26066

## IMPORTANT NOTIFICATION

International application No.  
PCT/DK99/00171International filing date (day/month/year)  
25/03/1999Priority date (day/month/year)  
08/04/1998

Applicant

VELUX INDUSTRI A/S et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

## 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference IPB/26066	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/DK99/00171	International filing date (day/month/year) 25/03/1999	Priority date (day/month/year) 08/04/1998
International Patent Classification (IPC) or national classification and IPC F16H19/00		
Applicant VELUX INDUSTRI A/S et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 15 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  26/07/1999	Date of completion of this report  18.05.00
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  H. KNOESEL  Telephone No. +49 89 2399 8916  

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/DK99/00171

## I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

### Description, pages:

4-14	as originally filed			
1	as received on	15/11/1999	with letter of	12/11/1999
2,3,3a	as received on	03/12/1999	with letter of	30/11/1999

### Claims, No.:

4-11,13-49	as received on	15/11/1999	with letter of	12/11/1999
1-3,12	as received on	03/12/1999	with letter of	30/11/1999

### Drawings, sheets:

1/11-11/11	as originally filed
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2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/DK99/00171

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-49
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-49
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-49
	No:	Claims	

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

As section V is concerned:

1. The pending application according to claim 1 is concerned with  
**A method of making an elongate spindle member having significant rigidity and stability against pressure and/or tensile loads as well as bending and torsional loads, whereby said spindle member acts between two objects, comprising the steps of:**
  - winding-up of a plurality of mutually interlocking chain links (1,12) under axial displacement in a helical winding (5,16) to form said elongate spindle member,
  - using chain links formed with a substantially circular curvature on their exterior sides and including associated engagement means,
  - drivingly connecting said chain links to a rotatable driving device (3,4;15,26) arranged in a winding guide means (14) connected with one of said two objects,
  - guiding said chain links during rotation of said driving device in said winding guide means (14) so that the chain links are interconnected and retained in engagement by their associated engagement means with neighbouring chain links in the same turn as well as adjacent chain links in neighbouring turns of said elongate spindle member, and
  - coupling the helical winding with the other of said two objects by means of a coupling member (6,18).

This method of making such an elongate spindle by using curved chain links having associated e and winding them up in the way as described in claim 1 is novel and no hint can be found in any of the cited documents in this direction. With this method it is possible to produce stable and rigid elongate spindle members of any wanted length in a simple and easy manner.

The features of claim 1 are neither known from, nor rendered obvious by, the available prior art cited in the International Search Report.

The further claims 2 to 11 are appended to claim 1 and as such meet the requirements of the PCT.

2. The further claims 12 to 34 are concerned with an apparatus for carrying out the

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/DK99/00171

method of the foregoing claims and make a reference thereto and as such meet the requirements of PCT.

3. Independent claim 35 is then concerned with the special elongate chain having interlocking chain links of circular curvature and associated engagement means to be used in the apparatus of claim 12 to 34 is likewise novel and inventive over the prior art which does not give any hint in the direction of such a special chain and its use.

The dependent claims 36 to 49 appended to claim 35 comprise further details which meet with claim 35 the requirements of the PCT.

4. The industrial applicability is doubtless given.

As section VII is concerned:

5. Claim 13 is not in line with claim 12 in which the coupling is already defined.

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>IPB/26066</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/DK 99/ 00171</b>	International filing date (day/month/year) <b>25/03/1999</b>	(Earliest) Priority Date (day/month/year) <b>08/04/1998</b>
Applicant  <b>VELUX INDUSTRI A/S et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

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☐ None of the figures.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 99/00171

## Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

The abstract is modified as follows:

line 6: after "links" insert "(1)";  
line 7: after "winding" insert "(5)";  
line 8: after "means" insert "(14)";



## INTERNATIONAL SEARCH REPORT

International Application No

/DK 99/00171

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F16H19/00 F16H49/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 44 18 876 A (FLAMME KLAUS PETER DIPL ING) 18 January 1996 see the whole document ---	1,12
A	US 2 131 261 A (ALDEEN GEDOR W ET AL) 27 September 1938 see the whole document ---	1,12
A	EP 0 301 453 A (SWF AUTO ELECTRIC GMBH) 1 February 1989 see column 2, line 14 - line 54; figures -----	

☐

Further documents are listed in the continuation of box C.

☒

Patent family members are listed in annex.

## ° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

22 June 1999

Date of mailing of the international search report

28/06/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Daehnhardt, A

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

DK 99/00171

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 4418876	A	18-01-1996	NONE	
US 2131261	A	27-09-1938	NONE	
EP 0301453	A	01-02-1989	DE 3724855 A	09-02-1989
			WO 8901099 A	09-02-1989
			JP 2500125 T	18-01-1990

# PATENT COOPERATION TREATY

# PCT

REC'D 22 MAY 2000

PO

PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT



(PCT Article 36 and Rule 70)

Applicant's or agent's file reference IPB/26066	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/DK99/00171	International filing date (day/month/year) 25/03/1999	Priority date (day/month/year) 08/04/1998
International Patent Classification (IPC) or national classification and IPC F16H19/00		
Applicant VELUX INDUSTRI A/S et al.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 5 sheets, including this cover sheet.  
  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  
  
 These annexes consist of a total of 15 sheets.

- This report contains indications relating to the following items:

- ☒ Basis of the report
- ☐ Priority
- ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Lack of unity of invention
- ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Certain documents cited
- ☒ Certain defects in the international application
- ☐ Certain observations on the international application

Date of submission of the demand  26/07/1999	Date of completion of this report  18.05.00
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  H. KNOESEL  Telephone No. +49 89 2399 8916  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/DK99/00171

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

4-14	as originally filed			
1	as received on	15/11/1999	with letter of	12/11/1999
2,3,3a	as received on	03/12/1999	with letter of	30/11/1999

**Claims, No.:**

4-11,13-49	as received on	15/11/1999	with letter of	12/11/1999
1-3,12	as received on	03/12/1999	with letter of	30/11/1999

**Drawings, sheets:**

1/11-11/11	as originally filed
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2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/DK99/00171

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-49
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-49
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-49
	No:	Claims	

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

As section V is concerned:

1. The pending application according to claim 1 is concerned with  
**A method of making an elongate spindle member having significant rigidity and stability against pressure and/or tensile loads as well as bending and torsional loads, whereby said spindle member acts between two objects, comprising the steps of:**
  - winding-up of a plurality of mutually interlocking chain links (1,12) under axial displacement in a helical winding (5,16) to form said elongate spindle member,
  - using chain links formed with a substantially circular curvature on their exterior sides and including associated engagement means,
  - drivingly connecting said chain links to a rotatable driving device (3,4;15,26) arranged in a winding guide means (14) connected with one of said two objects,
  - guiding said chain links during rotation of said driving device in said winding guide means (14) so that the chain links are interconnected and retained in engagement by their associated engagement means with neighbouring chain links in the same turn as well as adjacent chain links in neighbouring turns of said elongate spindle member, and
  - coupling the helical winding with the other of said two objects by means of a coupling member (6,18).

This method of making such an elongate spindle by using curved chain links having associated e and winding them up in the way as described in claim 1 is novel and no hint can be found in any of the cited documents in this direction. With this method it is possible to produce stable and rigid elongate spindle members of any wanted length in a simple and easy manner.

The features of claim 1 are neither known from, nor rendered obvious by, the available prior art cited in the International Search Report.

The further claims 2 to 11 are appended to claim 1 and as such meet the requirements of the PCT.

2. The further claims 12 to 34 are concerned with an apparatus for carrying out the

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/DK99/00171

method of the foregoing claims and make a reference thereto and as such meet the requirements of PCT.

3. Independent claim 35 is then concerned with the special elongate chain having interlocking chain links of circular curvature and associated engagement means to be used in the apparatus of claim 12 to 34 is likewise novel and inventive over the prior art which does not give any hint in the direction of such a special chain and its use.

The dependent claims 36 to 49 appended to claim 35 comprise further details which meet with claim 35 the requirements of the PCT.

4. The industrial applicability is doubtless given.

As section VII is concerned:

5. Claim 13 is not in line with claim 12 in which the coupling is already defined.

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A method and an apparatus for transfer of pressure and/or tensile load and an elongate chain for use therein.

The present invention relates to a method and an apparatus of making an elongate spindle member having significant rigidity and stability against pressure and/or tensile loads as well as bending and torsional loads, whereby said spindle member acts between two objects.

According to the invention a transfer of pressure and/or tensile and possibly torque loads between two mutually movable objects is provided, which is suitably applicable for a number of practical purposes and based on hitherto unknown mechanical principles. Non-exhaustive examples of fields of use aimed at by the invention may be raising/lowering devices for mutually height displaceable objects, for instance jacks or motor-operated lifting devices of any kind, and operator mechanisms for the opening and closing of windows, doors and gates.

The method according to the invention comprises the steps of

- winding-up of a plurality of mutually interlocking chain links under axial displacement in a helical winding to form said elongate spindle member,
- using chain links formed with a substantially circular curvature on their exterior sides and including associated engagement means,
- drivingly connecting said chain links to a rotatable driving device arranged in a winding guide means connected with one of said two objects,
- guiding said chain links during rotation of said driving device in said winding guide means so that the chain links are interconnected and retained in engagement by their associated engagement means with neigh-

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bouring chain links in the same turn as well as adjacent chain links in neighbouring turns of said elongate spindle member, and

- coupling the helical winding with the other of said two objects by means of a coupling member.

By winding mutually interlocked chain links in this manner in a helical winding under active retainment of the individual chain links in their positions in the helical winding, it has turned out to be possible to provide a spindle device having significant stability against pressure and/or tensile loads as well as bending and torsional loads and which may act as a pressure bar or drawbar or torque shaft between two objects.

According to a preferred embodiment of the method of the invention a reversibly rotatable driving device is used, said device increasing by rotation in one direction of rotation the length of the spindle device during winding of the chain links in said helical winding and reduces by rotation in the opposite direction of rotation the length of the spindle device during unwinding of the chain links from said helical winding.

Further embodiments of the method and non-exhaustive examples of its application are described in the dependent claims 2 - 11.

For carrying out the method the apparatus according to the invention is characterized in comprising, in connection with one of said two objects, a chain storage with an elongate chain of interlocking chain links having a substantially circular curvature on their exterior sides and including associated engagement means, a guide means for advancing the elongate chain, a winding guide means connected with the advancing guide means and comprising a guide for engagement

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with a guide member on the chain links for winding said helical winding a rotatable driving device arranged in said winding guide means axial advancement of the spindle device produced by the helical winding and a coupling member for coupling the helical winding with the other of said two objects.

Advantageous embodiments of the apparatus and non-exhaustive examples of use are described in the dependent claims 13 to 34.

The invention further relates to an elongate chain comprising interlocking chain links with associated engagement means for use in the apparatus.

According to the invention the elongate chain is characterized in each chain link has a substantially circular curvature on its exterior sides and, in unfolded projection, substantially the shape of a parallelogram with a first pair of engagement means for connection with neighbouring chain links in the same turn of the helical winding provided at a first pair of opposite sides and further engagement means for engagement with corresponding engagement means on adjacent chain links in neighbouring turns of the helical winding provided at a second pair of opposite sides.

The invention will be explained in the following by means of an embodiment and with reference to the partly schematic drawing, in which

Figs 1 and 2 are schematic, perspective views illustrating the principle of the method according to the invention,

Figs 3 and 4 show an embodiment of an apparatus according to the invention,

Fig. 5 shows an embodiment of the apparatus with integrated chain storage,

Figs 6 and 7 show embodiments of a winding guide means and a drive means in the apparatus according to

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3a

Figs 3 and 4,

Figs 8 - 12 show an embodiment of a chain link for use in the apparatus according to Figs 3 and 4,

Fig. 14 is a perspective view illustrating the winding up of the interlocking chain links in a helical winding under mutual retainment,

Fig. 15 is a schematical perspective view of a first alternative embodiment, in which two spindle members of equal diameter are formed by individual helical windings produced from individual sets of chain links,

Fig. 16 is a schematical sectional view of a second alternative embodiment, in which two spindle members of different diameter are formed by individual helical windings produced from individual sets of chain links and extending one inside the other,

Fig. 17 is a schematical perspective view of an alternative embodiment, in which a single spindle device is formed from two individual sets of chain links, and

Fig. 18 is a perspective view of the application of the embodiment shown in fig. 15 in a window operator device.

As will appear from figs 1 and 2, the invention resides in its broadest aspect in that chain links 1,

P A T E N T   C L A I M S

1. A method of making an elongate spindle member having significant rigidity and stability against pressure and/or tensile loads as well as bending and torsional loads, whereby said spindle member acts between two objects, comprising the steps of

- winding-up of a plurality of mutually interlocking chain links (1, 12) under axial displacement in a helical winding (5, 16) to form said elongate spindle member,
- using chain links formed with a substantially circular curvature on their exterior sides and including associated engagement means,
- drivingly connecting said chain links to a rotatable driving device (3,4;15,26) arranged in a winding guide means (14) connected with one of said two objects,
- guiding said chain links during rotation of said driving device in said winding guide means so that the chain links are interconnected and retained in engagement by their associated engagement means with neighbouring chain links in the same turn as well as adjacent chain links in neighbouring turns of said elongate spindle member, and
- coupling the helical winding with the other of said two objects by means of a coupling member (6,18).

2. A method according to claim 1, c h a r a c -  
t e r i z e d by the use of a reversibly rotatable driving device (3, 4; 15, 26) as said driving device to increase and reduce the length of the spindle member by rotation of said driving device in one and the other direction of rotation, respectively.

3. A method according to claim 2, c h a r a c -  
t e r i z e d in that the coupling by means of said coupling member (6, 18) is effected by connection with the first produced turn of the helical winding.

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4. A method according to claim 2 or 3, characterized in that two elongate spindle members (57, 58; 67, 68) are formed by winding-up individual coherent sets of chain links (59, 60) in two helical windings with opposite pitch directions (65, 66), the winding guide means of said sets of chain links being connected with one and the other of said two objects, respectively.

5. A method according to claim 3 and 4, characterized in that the two helical windings (57, 58) have the same diameter and that coupling members (63, 64) connected with the first produced turn (61, 62) of each winding are connected with each other intermediate said two objects.

6. A method according to claim 2 and 4, characterized in that one of said helical windings (67) are advanced inside the other (68) and have chain links provided with an external threading (69) to engage an internal threading (70) in the chain links of the other helical winding to enable each of said helical windings to function as a coupling member for the other helical winding.

7. A method according to claim 2 or 3, characterized in that a single spindle device is formed by winding two separate sets of chain links (76, 77) in alternating turns in the same helical winding, both sets of chain links (72, 73) being supplied to the same winding guide means.

8. A method according to any of claims 2 to 7, characterized by its use in a raising/lowering device for mutual height displacement of the two objects.

9. A method according to any of claims 2 to 7, characterized by its use as an operator device for opening and closing windows or doors, in

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~~which said two objects are constituted by a stationary frame structure and an openable sash structure.~~

10. A method according to any of claims 2 to 7, characterized by its use as a drilling instrument, said coupling member being connected with a drill or cutter head.

11. A method according to any of claims 2 to 7, characterized by its use for reversible mutual displacement of telescopically connected tube members.

12. An apparatus for carrying out the method according to any of the preceding claims, characterized in comprising, in connection with one of said two objects, a chain storage (10) with an elongate chain (11) of interlocking chain links (12) having a substantially circular curvature on their exterior sides and including associated engagement means, a guide means (13) for advancing the elongate chain (11), a winding guide means (14) connected with the advancing guide means (13) and comprising a guide (22) for engagement with a guide member (34) on the chain links for winding said helical winding (16), a rotatable driving device (3,4;15,26) arranged in said winding guide means (14) for axial advancement of the spindle device produced by the helical winding (5) and a coupling member (6,18) for coupling the helical winding with the other of said two objects.

~~13. An apparatus according to claim 12, characterized in that said coupling means comprises a coupling member (6, 18) connected with an end turn of the helical winding.~~

14. An apparatus according to claim 12 or 13, characterized in that the chain storage (10) comprises an elongate track connected with the ~~advancing guide means (13) for receiving the chain (11)~~

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which said two objects are constituted by a stationary frame structure and an openable sash structure.

10. A method according to any of claims 2 to 7, characterized by its use as a drilling instrument, said coupling member being connected with a drill or cutter head.

11. A method according to any of claims 2 to 7, characterized by its use for reversible mutual displacement of telescopically connected tube members.

~~12. An apparatus for carrying out the method according to any of the preceding claims, characterized in comprising, in connection with one of said two objects, a chain storage (10) with an elongate chain (11) of interlocking chain links (12) having a substantially circular curvature on their exterior sides and including associated engagement means, a guide means (13) for advancing the elongate chain (11), a winding guide means (14) connected with the advancing guide means (13) for winding said helical winding (16), a rotatable driving device (3,4;15,26) arranged in said winding guide means (14) for axial advancement of the spindle device produced by the helical winding (5) and means for coupling the helical winding with the other of said two objects.~~

13. An apparatus according to claim 13, characterized in that said coupling means comprises a coupling member (6, 18) connected with an end turn of the helical winding.

14. An apparatus according to claim 12 or 13, characterized in that the chain storage (10) comprises an elongate track connected with the advancing guide means (13) for receiving the chain (11) in its entire length.

15. An apparatus according to claim 12 or 13,

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c h a r a c t e r i z e d in that the chain storage is constituted of a winch connected with the advancing guide means, on which winch the elongate chain is wound.

16. An apparatus according to any of claims 12 to 15, c h a r a c t e r i z e d in that the winding guide means (14) comprises a substantially part-cylindrical wall (21), on the interior side of which a guide (22) is provided for engagement with a guide member (34) on the chain links (12).

17. An apparatus according to claim 16, c h a - r a c t e r i z e d in that which said guide is designed as at least one thread-rib (22) with a predetermined pitch across part of the interior side of said part-cylindrical wall (21).

18. An apparatus according to claim 17, c h a - r a c t e r i z e d in that the advancing guide means (13) comprises a substantially linear guide rail (20) for controlled advancement of the chain links (12) towards the winding guide means and a guide surface (19, 24) for the exterior side (32) of the chain links, which guide surface is connected substantially in a tangential plane with the interior side of the part-cylindrical wall (21) of the winding guide means, said guide surface (19, 24) having near its connection to said interior side at least one advancing guide member (25)

19. An apparatus according to claim 18, c h a - r a c t e r i z e d in that the advancing guide member (25) comprises a member protruding from the advancing guide surface (24) for introducing each chain link (12) into the winding guide means (14) with an axial displacement component.

20. An apparatus according to any of claims 16 to 19, c h a r a c t e r i z e d in that the drive means



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comprises an advancing wheel (26), which is provided in a peripheral surface with a number of oblique teeth (27) having a predetermined second pitch directed opposite to the pitch of said thread-rib (22), said advancing wheel being journaled coaxially in the winding guide means (14) for engagement with the chain links (12) and being connected with a drive wheel (15) coupled to drive means via a transmission.

21. An apparatus according to claim 13 and any of claims 16 to 20, characterized in that said coupling member (18) is designed as a substantially disc-shaped cover member with a substantially circular edge surface (51), in which a guide member (52) is provided for engagement with said guide (22) in the winding guide means (14), whereas the cover member is provided, on one side surface (53), with protruding engagement means (54) for engagement with each their respective chain link (12) in the first turn (17) formed in the helical winding (16).

22. An apparatus according to claim 21, characterized in that said protruding engagement means (54) comprises a hook member (55).

23. An apparatus according to claim 21 or 22, characterized in that said protruding engagement means (54) comprises a groove (56).

24. An apparatus according to any of claims 21 to 23, characterized in that said guide member on the edge surface (51) of the coupling member (18) comprises a track (52) for receiving said thread-rib (22) in the winding guide means.

25. An apparatus according to any of claims 12 to 24, characterized in that the helical winding (5) formed by the winding of the chain links (1) is surrounded by a casing (8) of variable length.

26. An apparatus according to claim 25, characterized in that

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r a c t e r i z e d in that said casing is a bellow.

27. An apparatus according to any of claims 12 to 26, c h a r a c t e r i z e d in that a chain storage, advancing guide means and winding guide means are provided in connection with each of said two objects for producing two elongate spindle members (57, 58; 67, 68) by winding-up of two helical windings with opposite pitch directions.

28. An apparatus according to claims 13 and 27, c h a r a c t e r i z e d in that the two helical windings (57, 58) have the same diameter and that coupling members (63, 64) connected with the first produced turn (61, 62) of each winding are connected with each other intermediate said two objects.

29. An apparatus according to claim 19 and claim 27, c h a r a c t e r i z e d in that one of said helical windings (67) are advanced inside the other (68) and have chain links provided with an external threading (69) to engage an internal threading (70) formed by said helical track in the interior side of the chain links of the other helical winding (68) to enable each of said helical windings to function as a coupling member for the other helical winding.

30. An apparatus according to any of claims 12 to 29, c h a r a c t e r i z e d in that a single spindle device (75) is formed comprising a helical winding of alternating turns of chain links (76, 77) supplied from two separate sets of chain links.

31. An apparatus according to any of claims 12 to 30, c h a r a c t e r i z e d by its use in a raising/lowering device for mutual height displacement of the two objects.

32. An apparatus according to any of claims 12 to 30, c h a r a c t e r i z e d by its use as an operator device for opening and closing windows or doors,

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in which said two objects are constituted by a stationary frame structure and an openable sash structure.

33. An apparatus according to any of claims 13 to 30, characterized by its use as a drilling instrument, said coupling member being connected with a drill or cutter head.

34. An apparatus according to any of claims 12 to 30, characterized by its use for reversible mutual displacement of telescopically connected tube members.

35. An elongate chain comprising interlocking chain links (12) with associated engagement means for use in an apparatus according to any of claim 12 to 34, characterized in that each chain link (12) has a substantially circular curvature on its exterior sides and, in unfolded projection, substantially the shape of a parallelogram with a first pair of engagement means (43, 44) for connection with neighbouring chain links in the same turn of the helical winding provided at a first pair of opposite sides (28, 29) and further engagement means (49, 50) for engagement with corresponding engagement means on adjacent chain links in neighbouring turns of the helical winding provided at a second pair of opposite sides (30, 31).

36. A chain according to claim 35 for use in an apparatus according to claim 17, characterized in that each chain link (12) is in its exterior side (32) with a track (34) adapted to receive said thread-rib (22) in the winding guide means, said track forming with said first pair of opposite sides (28, 29) an angle ( $\alpha$ ) adapted to said predetermined pitch.

37. A chain according to claim 36 for use in an apparatus according to claim 18, characterized in that an interior side (33) of each chain

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links (12) is formed with engagement means (45) for engagement with the substantially linear guide rail (20) in the advancing guide means (13) and that said exterior side of each chain link (12) is provided with  
5 a second guide member (35) for introducing the chain link (12) into the winding guide means (14) with an orifice (38) of said track (34) orientated towards a first end (23) of said thread-rib (22), said orifice opening in the downstream side (28) of said first pair  
10 of opposite sides with respect to the direction of advancement.

38. A chain according to claim 37, c h a r a c -  
t e r i z e d in that said second guide member (35) comprises a second track provided in said exterior side  
15 and ending in said first pair of opposite sides (28, 29) in track orifices (36, 37) displaced in a direction parallel to said first pair of sides (28, 29).

39. A chain according to any of claims 35 to 38 for use in an apparatus according to claim 20, c h a -  
20 r a c t e r i z e d in that a guide member (39) is formed in an interior side (33) of each chain link (12), said guide member (39) being designed as a helical track which on the interior side of the helical winding (16) formed by the chain links forms a number  
25 of coherent helical tracks (42) with said second pitch for engagement with individual ones of the oblique teeth (27) of the advancing wheel (26) of said driving device.

40. A chain according to claim 37, c h a r a c -  
30 t e r i z e d in that said engagement means (45) form part of a second pair of engagement means (45, 47) provided at said first pair of opposite sides (28, 29) and being brought into engagement with opposite means on neighbouring links in the same turn (17) by the  
35 winding of the chain links, to retain the chain links

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(12) in their positions in said winding.

41. A chain according to any of claims 35 to 40 for use in an apparatus according to claim 22, characterized in that the first pair of engagement means for each chain link (12) comprises a hook-shaped hinge member (44) and a curved track (43) for receiving said hinge member (44), respectively, said curved track (43) being adapted to receive the hook member (55) of said coupling member (18).

42. A chain according to claim 40 and 41 for use in an apparatus according to claim 18, characterized in that said second pair of engagement means for each chain link (12) comprises as a fork member (45) provided at a free edge of a wall portion defining said curved track (43) for engagement, on one hand, with said guide rail (20) in the advancing guide means (13) and, on the other hand, with a rib member (47) provided in an interior side of said hook-shaped hinge member (44), said fork and rib members (45, 47) preventing mutual displacement of neighbouring chain links in the same turn in the axial direction of the helical winding by engagement with a rib member (47) and a fork member (45), respectively, on each of respective neighbouring chain links, the hook-shaped hinge member (44) being provided, on each side of said rib member (47), with abutment surfaces (48a, 48b) serving as stop for branches (45a) of said fork member (45) for retaining neighbouring chain links in a predetermined angular position in said turn.

43. A chain according to claim 42, characterized in that said mutually engaging fork and rib members (45, 47) are positioned in such a way relative to one another that said curved tracks (43) on a chain link (12) are brought into engagement with hook-shaped hinge members (44) in chain links posi-

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tioned side by side in the same turn and a neighbouring turn.

44. A chain according to any of claims 35 to 43 for use in an apparatus according to claim 23, characterized in that said further engagement means comprises a track (49) in the exterior side (32) of the chain link (12) and a rib member (50) along one side and the other, respectively, of said second pair of opposite sides (30, 31), said rib member (50) being adapted to engage the groove (56) on said coupling member (18).

45. A chain according to any of claims 35 to 44, characterized in that each chain link (12) has a length different from an even fraction of a circle having the radius of said helical winding.

46. A chain according to claim 45, characterized in that the length of each chain link (12) constitutes an odd fraction of a circle.

47. An apparatus according to claim 46, characterized in that the length of each chain link (12) constitutes a fifth of the peripheral length of the interior wall side of the winding guide means (14).

48. A chain according to any of claims 35 to 47, characterized in that the chain links (12) are moulded from plastics material.

49. A chain according to any of claims 35 to 47, characterized in that the chain links (12) are made as cast or sintered metal bodies.

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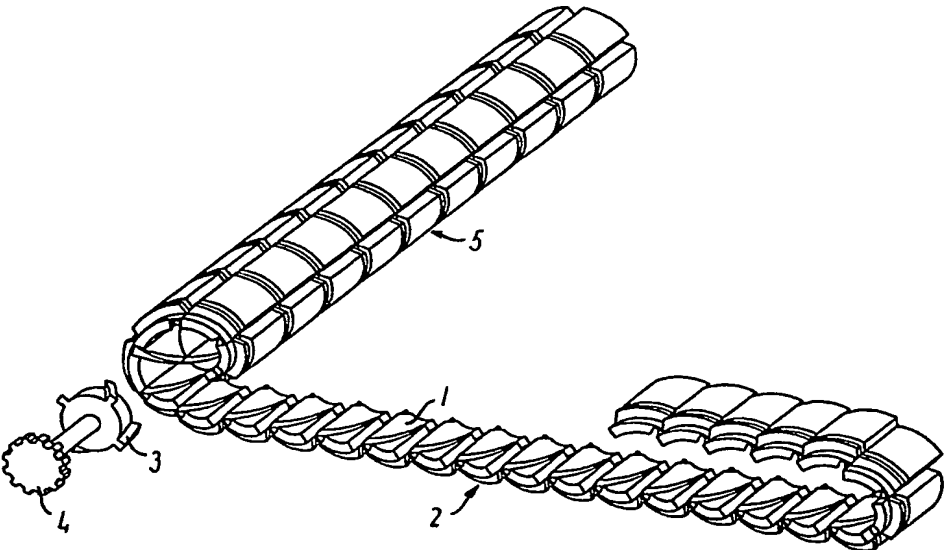
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<b>(21) International Application Number:</b> PCT/DK99/00171 <b>(22) International Filing Date:</b> 25 March 1999 (25.03.99) <b>(30) Priority Data:</b> 0512/98 8 April 1998 (08.04.98) DK <b>(71) Applicant (for all designated States except US):</b> VELUX INDUSTRI A/S [DK/DK]; Tobaksvejen 10, DK-2860 Søborg (DK). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> SØRENSEN, Jens, Jørren [DK/DK]; Blekingegade 1, DK-2300 Copenhagen S (DK). <b>(74) Agents:</b> RAFFNSØE, Knud, Rosenstand et al.; Internationalt Patent-Bureau, Høje Taastrup Boulevard 23, DK-2630 Taastrup (DK).		<b>(81) Designated States:</b> AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> A METHOD AND AN APPARATUS FOR TRANSFER OF PRESSURE AND/OR TENSILE LOAD    <b>(57) Abstract</b>  For transfer of pressure and/or tensile loads as well as torque load between two objects, an elongate spindle member with high rigidity and stability against pressure and/or tensile loads as well as bending and torsional load is provided by that winding-up of mutually interlocking chain links (1) under axial displacement in a helical winding (5) by means of a winding guide means (14) connected with one of the two objects. The turn of the helical winding first provided is connected with a coupling member for connection with the other two objects and each chain link is retained in engagement with neighbouring links in the same turn as well as adjacent chain links in neighbouring turns.		



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A method and an apparatus for transfer of pressure and/or tensile load.

The present invention relates to a method and an apparatus for transfer of pressure and/or tensile load between two objects.

According to the invention a transfer of pressure and/or tensile and possibly torque loads between two mutually movable objects is provided, which is suitably applicable for a number of practical purposes and based on hitherto unknown mechanical principles. Non-exhaustive examples of fields of use aimed at by the invention may be raising/lowering devices for mutually height displaceable objects, for instance jacks or motor-operated lifting devices of any kind, and operator mechanisms for the opening and closing of windows, doors and gates.

The method according to the invention is characterized in that an elongate spindle member with high rigidity and stability against pressure and/or tensile load as well as bending and torsional load is provided by winding-up of mutually interlocking chain links under axial displacement in a helical winding by means of a winding guide means connected with one of said two objects and a driving device, a coupling member being provided for connection of the helical winding with the other of said two objects, each chain link being retained in engagement with neighbouring links in the same turn as well as adjacent chain links in neighbouring turns.

By winding mutually interlocked chain links in this manner in a helical winding under active retainment of the individual chain links in their positions in the helical winding, it has turned out to be possible to provide a spindle device having significant stability against pressure and/or tensile loads as

cant stability against pressure and/or tensile loads as well as bending and torsional loads and which may act as a pressure bar or drawbar or torque shaft between two objects.

5       According to a preferred embodiment of the method of the invention a reversibly rotatable driving device is used, said device increasing by rotation in one direction of rotation the length of the spindle device during winding of the chain links in said helical  
10 winding and reduces by rotation in the opposite direction of rotation the length of the spindle device during unwinding of the chain links from said helical winding.

Further embodiments of the method and non-exhaustive  
15       examples of its application are described in the dependent claims 2 - 11.

For carrying out the method the apparatus according to the invention is characterized in comprising, in connection with one of said two objects, a chain  
20 storage with an elongate chain of interlocking chain links, a guide means for advancing the elongate chain, and a winding guide means connected with the advancing guide means for winding said helical winding and comprising a guide for engagement with a guide member  
25 on the chain links, whereas a coupling member is provided for connection of said helical winding with the other of said two objects, a driving means being provided for axial advancement of the spindle device produced by the helical winding.

30       Advantageous embodiments of the apparatus and its individual components as well as non-exhaustive examples of use are described in the dependent claims 13 to 44.

The invention will be explained in the following  
35 by means of an embodiment and with reference to the

partly schematic drawing, in which

Figs 1 and 2 are schematic, perspective views illustrating the principle of the method according to the invention,

5 Figs 3 and 4 show an embodiment of an apparatus according to the invention,

Fig. 5 shows an embodiment of the apparatus with integrated chain storage,

10 Figs 6 and 7 show embodiments of a winding guide means and a drive means in the apparatus according to Figs 3 and 4,

Figs 8 - 12 show an embodiment of a chain link for use in the apparatus according to Figs 3 and 4,

15 Fig. 14 is a perspective view illustrating the winding up of the interlocking chain links in a helical winding under mutual retainment,

Fig. 15 is a schematical perspective view of a first alternative embodiment, in which two spindle members of equal diameter are formed by individual 20 helical windings produced from individual sets of chain links,

Fig. 16 is a schematical sectional view of a second alternative embodiment, in which two spindle members of different diameter are formed by individual 25 helical windings produced from individual sets of chain links and extending one inside the other,

Fig. 17 is a schematical perspective view of an alternative embodiment, in which a single spindle device is formed from two individual sets of chain 30 links, and

Fig. 18 is a perspective view of the application of the embodiment shown in fig. 15 in a window operator device.

As will appear from figs 1 and 2, the invention 35 resides in its broadest aspect in that chain links 1,

which are mutually interlocked into an elongate chain 2, are wound into a helical winding 5 under mutual retainment by means of a drive means comprising an advancing wheel 3 in connection with a drive wheel 4 5 which may be connected via a transmission with a preferably reversibly rotatable drive motor (not shown), and by use of advancing and winding guide means.

The wound up helical winding thereby forms a 10 spindle device of variable length and considerable rigidity and stability against pressure, tensile, bending and torsional loads.

The winding up of the chain links 1 in the helical winding 5 takes place during rotation of the drive 15 wheel 4 in one direction of rotation, the length of the spindle device being increased under axial advancement and simultaneous rotation of the helical winding. If the direction of rotation of the drive wheel 4 is reversed, the chain links 1 will again become unwound 20 from the helical winding 5 and the spindle device formed thereby will be shortened.

When carrying out the method, a chain storage (not shown in figs 1 and 2) will be provided, together with advancing and winding guide means (not shown) and the 25 driving device in connection with one of the two objects, between which a power transfer is wanted, preferably a stationary first object, while a second object movable relative thereto may be connected, as shown in the intersected view in fig. 2, with the 30 spindle device 5 by means of a coupling member 6, which at the start of the winding up of the chain links 1 is connected with the turn 7 first formed in the helical winding 5.

As will likewise appear from fig. 2, the spindle 35 device formed by the helical winding 5 will for many

practical uses be protected by a surrounding, elongate cover member of variable length, for instance a bellow 8.

Based on the embodiment shown in figs 3 and 4 of 5 an apparatus according to the invention examples of the design of the individual components of the apparatus will be explained in the following.

In the embodiment shown in figs 3 and 4, the mutually interlocked chain links 12 are advanced in an 10 elongate chain 11 from a chain storage (not shown) by means of a substantially linear advancing guide member 13 towards a winding guide member 14, in which the drive means with the drive wheel 15 and the advancing wheel (not shown) are journaled by means of bearing 15 means (not shown).

By clockwise rotation of the drive wheel 15, the chain links 12 are wound, guided by the winding guide means 14, in the helical winding 16, in which the chain links 12 are positioned in closely packed turns 17 20 under mutual retainment, such that the wound up chain links are prevented from mutual displacement in the helical winding.

In the winding guide means 14, the chain links 12 first arriving are brought into engagement with a 25 coupling member 18 shown in fig. 3. While the advancing guide means 13, the winding guide means 14 and the drive means with the drive wheel 15 are placed in connection with one of the two objects, between which pressure and/or tensile as well as torque loads are to 30 be transferred by means of the apparatus, the coupling member 18 serves for connecting the spindle device 16 with the other of the two objects. The drive means may alternatively, together with the coupling member, be positioned in connection with the second object.

35 Fig. 5 shows, in a schematic plane view, how the

winding up guide means 14 and the advancing guide means 13 may be integrated in a common housing 9 with a chain storage in the shape of a track 10, in which the elongate chain 11 is received in its entire length.

5       The advancing guide means 13 is in the embodiment shown designed as a linear rail member with a bottom surface 19 forming an elongate advancing guide surface for a convex exterior side of the interlocked chain links 12, and a superjacent guide rail 20 which by  
10 engagement with engagement means at a concave interior side of the chain links 12 guides them safely towards the winding up guide means 14.

      The winding up guide means 14 is in the embodiment shown in fig. 6 formed with a substantially part-  
15 cylindrical wall 21, on the interior side of which a winding guide is formed by a thread-rib 22, which in the embodiment shown extends with a predetermined pitch across slightly more than 360° of the interior periphery of the wall 21. At one end 23 of the thread-rib 22,  
20 the interior side of the part-cylindrical wall 21 joins in a tangential plane in an extension 24 of the advancing guide surface 19. An advancing guide means 25 in the form of a protruding member for engagement with a track in the exterior side of the chain links 12 is  
25 connected with the advancing guide surface 24. This will be explained in detail in the following.

      In the embodiment of the drive means shown in fig. 7, the drive means 15 is connected with an advancing wheel 26 which is provided, in a peripheral surface,  
30 with a number of oblique teeth with a predetermined pitch directed oppositely to the pitch of the threaded groove 22 on the interior side of the cylindrical wall 21 in the winding guide means 14. As will be explained in detail in the following, the advancing wheel 26 with  
35 the teeth 27 engages, during winding up of the chain

links 12, a helical track in the interior side of the chain links 12 and thereby brings about an axial advancement of the helical winding provided during winding-up under simultaneous rotation of the helical winding about its axis.

As will be seen from the projected view in fig. 12, the individual chain links 12 have, in an unfolded projection, substantially the shape of a parallelogram with a first pair of opposite sides 28 and 29 and a second pair of opposite sides 30 and 31.

As more clearly seen in figs 8 - 11 the chain links 12 have a substantially circular curvature with a convex exterior side 32 and a concave interior side 33, such that, when wound up, the chain links 12 form the substantially circular-cylindrical helical winding 16. To prevent joints between chain links 12 in the individual turns 17 in the helical winding 16 from being positioned diametrically opposite one another, the chains 12 have a length differing from an even circle fraction, preferably with an odd number of chain links 12 in each turn depending on the desired dimensions of the helical winding made. In practice, 5 chain links per turn have proved suitable for many purposes, such as will be most clearly seen from figs. 5 and 14.

For engagement with the winding guide in the winding guide means 14 formed by the thread-rib 22, a substantially linear track 34 is provided as a guide member in the convex exterior side 32 of each chain link, said track forming with the first pair of opposite sides 28 and 29 an angle  $\nu$  determined by the pitch angle of the thread-rib 22 relative to the axis of the part-cylindrical wall 21 of the winding guide means 14.

For engagement with the member 25 protruding as an advancing guide member from the extension 24 of the advancing guide surface, each chain link 12 comprises



in the convex exterior side 32 as a second guide member a track 35 with two axially displaced track portions 35a and 35b which in each of a first pair of opposite sides 28 and 29 of the chain link 12 end in track orifices 36, 37 displaced in a direction parallel with the sides 28, 29. This design of the track brings each chain link 12 from the advancing guide surface 19, 24 into the winding guide means 14 with an axial displacement component and the orifice 38 of the track 34 at the downstream side 28 in the advancing direction, will be orientated against and aligned with the inlet end 23 of the thread-rib 22.

For engagement with the oblique teeth 27 on the advancing wheel 26 in the embodiment shown, a helical track 39 is provided in the concave interior side 33 of each chain link, as shown in Figs 10 and 11, said track being in the embodiment shown oriented substantially diagonally between track orifices 40 and 41 in each of the second pair of opposite sides 30 and 31. This form of the track has the effect that in the interior side of the wound up helical winding, a number of continuous, coherent helical tracks 42 is formed for engagement with each theirs of the corresponding number of oblique teeth 27 on the advancing wheel 26. If the drive means is alternatively connected with the coupling member 18, the interior tracks 39 may be dispensed with. Thereby, the chain links may ultimately be formed so as to substantially close the internal cavity of the spindle device to improve the rigidity and stability thereof.

For retaining the individual chain links 12 in their mutual positions in the turn 17 of the helical winding 16, each chain link 12 is provided with various pairs of co-operating engagement means.

Thus, a first pair of co-operating engagement

means for connecting each chain link 12 with its neighbouring chain links comprises a curved track 43 and a hook-shaped hinge member 44 at each of the first pair of opposite sides 28 and 29 of the chain link. The shape of the track 43 and the hinge member received therein are adapted to one another and the track 43 has a depth, such that, in the wound up helical winding 16, the hinge member is pushed completely into the groove 43, as shown in Fig. 14.

10 A second pair of co-operating engagement means comprises a fork member 45 provided in the interior wall 46 of the curved track 43 and a rib member 47 provided at the interior side of the hook-shaped hinge member 44. By the engagement of the fork and rib members 45 and 47 with a rib member 47 and a fork member 45, respectively, on each of neighbouring chain links in the same turn, neighbouring chain links in the same turn 17 are prevented from mutual displacement in the axial direction of the helical winding produced.

20 On the interior side of the hook-shaped hinge member 44 abutment surfaces 48 for the branches 45a of the fork member 45 are further provided. Through the abutment of the fork branches 45a against the surfaces 48, the winding movement of the chain link 12 is stopped, such that neighbouring chain links in the same turn 17 are retained in their mutual angular position, which is determined by the number of chain links in the turn.

As shown in fig. 3 the fork member 45 further serves as engagement member for the guide rail 20 in the advancing guide means 13.

As will appear from figs 10, 11 and 14 the fork and rib members 45 and 47 on each chain link 12 are further axially displaced relative to one another. Hereby is attained that the curved track 43 in the

entrance side 28 of each chain link at the winding in the helical winding, in addition to maintaining its engagement with the hook-shaped hinge member 44 on the previously introduced chain link 12, is brought into  
5 overlapping engagement with the hook-shaped hinge member 44 on the chain link in the turn formed immediately prior thereto in the helical winding 16, which is adjacent to this previously introduced chain link. This engagement has the effect that neighbouring turns 17 in  
10 the helical winding 16 are retained against mutual displacement in a plane perpendicular to the axial direction.

Finally, each of the chain links 12 is provided, at each of the second pair of opposite sides 30 and 31,  
15 with further engagement means which comprise a track 49 in the convex exterior side 32 of the chain link and a rib member 50 along one and the other side 30 and 31, respectively. By engagement of the track 49 and the rib member 50 with corresponding engagement means on  
20 adjacent chain links in neighbouring turns is ensured, by the winding-up of the chain links 12 in the helical winding, that chain links in neighbouring turns positioned side by side are secured in mutual engagement.

The coupling member 18, with which the winding 17  
25 first formed in the helical winding 16 is connected during the winding up of the chain link 12, is in the embodiment shown in Fig. 13 designed as a substantially disc-shaped cover member with a substantially circular-cylindrical edge surface 51, in which a track 52 is  
30 provided as a guide member for engaging the thread-rib 22 in the winding guide means 14, said track being substantially identical to the track 34 in the convex exterior side 32 of each chain link.

On the side surface 53 facing the helical winding  
35 16, the coupling member 18 is provided with a number of

protruding engagement means 54 corresponding to the number of chain links 12 in each turn of the helical winding 16, the height of said protruding engagement means 54 from side surface 53 increasing in accordance with the pitch of the wound up helical winding 16.

As the chain links 12, as mentioned above, are introduced in the winding guide means 14 with the side 28 with the curved track 43 in front and the side 31 with the rib member 50 facing outwards towards the coupling member 18, each of the engagement means 54 is provided with a hook-shaped hinge member 55 corresponding to the hook-shaped hinge member 44 on each chain link 12 and with an engagement track 56 for engagement with the rib member 50 on a chain link in the turn first formed.

By providing the chain links 12 and the coupling member 18 with the described co-operating engagement means, the chain links 12 will be safely secured and locked relative to each other in the wound up helical winding 16, which then together with the coupling member 18 provides a spindle device having considerable rigidity and high stability towards pressure and tensional load as well as towards bending, torsional and torque loads.

In fig. 15 an embodiment of the method an apparatus of the invention is illustrated, by which two spindle devices 57 and 58 are formed in linear extension of each other by winding-up chain links 59 and 60, respectively, from individual chains in separate helical windings having the same diameter. By provision of individual advancing guide means and winding guide means for the two spindle devices 57 and 58 at one and the other of the two objects to be interconnected, the chain storage needed to produce a given maximum length of the total spindle device may be evenly distributed

between the two objects.

In each helical winding the first produced turn 61 and 62, respectively, is connected with a coupling member 63 and 64, respectively, which coupling members 5 are connected with each other intermediate the two objects, which are not shown in fig. 15.

The pitch direction of the helical windings of the two spindle devices 57 and 58 are opposite as illustrated by arrows 65 and 66, respectively, so that for 10 the two opposite directions of revolution the length of both spindle devices 57 and 58 will either increase or decrease at the same time.

Fig. 16 shows another alternative embodiment, in which one spindle device 67 of two individual spindle 15 devices 67 and 68 having opposite pitch directions to function in the same way as escribed above, is formed is formed with an external threading 69 engaging an internal threading 70 formed by the helical track in the interior side of the chain links of the other 20 spindle device 68.

Also in this case, the advancing and winding guide means 71 and 72, respectively, for the helical windings of spindle devices 67 and 68 are provided at one and the other of the two objects 73 and 74 constituting 25 e.g. main frame and sash members of an openable window, respectively, whereas each of spindle devices 67 and 68 functions as a coupling member for the other spindle device, so that separate coupling members for the first produced turn of each spindle device are dispensed 30 with. By the simultaneous winding-up of the two spindle devices 67 and 68 from one and the other of the two objects, the spindle device 67 will simply gradually be screwed into the spindle device 68.

By this arrangement the rigidity and stability of 35 the overall spindle resulting from the combination of

the individual spindle devices 67 and 68 is further increased.

Fig. 17 shows a further alternative embodiment, in which a single spindle device 75 is formed by winding-up two separate individual sets of chain links 76 and 77 in alternating turns of the helical winding. The two chains comprising links 76 and 77, respectively, are advanced towards a common winding guide means (not shown) of the same principal construction as shown in 10 figs. 3 and 4 so as to enter the part cylindrical wall of the winding guide means at two points that are preferably diametrically opposite to each other. Compared to the embodiments described hereinbefore the winding guide means must have an internal threaded rib 15 for each of the separate sets of chain links 76 and 77, each of said threaded ribs having a pitch and the form of the external tracks in the chain links corresponding to tracks 34 and 35 in figs. 8 and 9 being dimensioned to impart an axial displacement component to the chain 20 links entering the winding guide means sufficient to allow the winding-up of chain links 72 and 73 in alternating turns.

By this alternating turn design of the spindle device the chain supply needed to produce a spindle 25 device of a given length can be divided into two separate chains arranged on either side of the winding guide means. By use of the apparatus in a window operator this design will facilitate arrangement of the operator housing including the winding guide means in 30 the middle of a main frame or sash member.

Fig. 18 shows an example of application of the embodiment schematically illustrated in fig. 15 in an operator device for a window having a main frame 78 and an openable sash 79, which are pivotally connected with 35 each other by hinge means (not illustrated) provided at

opposed bottom members 80 and 81 of the main frame and sash structures. Operator housings 82 and 83 arranged on opposed top members 84 and 85 of the main frame and sash structures accommodate a chain storage with associated advancing guide means, winding guide means and drive means for the winding-up of chain links from each chain in the helical windings forming the two spindle devices 57 and 58, which are connected end by end by means of the coupling members 63 and 64.

10       It is within the scope of the invention possible to design the individual components of the apparatus in other ways. The number of chain links in each turn in the helical winding will thus depend on the dimensions of the spindle device suitable for the purpose in  
15 question. The coupling member connecting the spindle device with the second one of the two objects to be connected, may be connected with the helical winding in other ways, for instance as shown in Fig. 2 with a bushing member, fastened in the interior of the helical  
20 winding. Also the chain links may be designed in other ways, provided the functional conditions in respect of winding, axial advancement in the helical winding and mutual securing be met, the object of said conditions being to prevent relative movement between the individ-  
25 ual chain links and between individual turns in the helical winding.

## P A T E N T   C L A I M S

1. A method for transfer of pressure and/or tensile load between two objects, c h a r a c t e r - i z e d in that an elongate spindle member with high  
5 rigidity and stability against pressure and/or tensile load as well as bending and torsional load is provided by winding-up of mutually interlocking chain links (1, 12) under axial displacement in a helical winding (5, 16) by means of a winding guide means (14) connected  
10 with one of said two objects and a driving device (3, 4; 15, 26), a coupling member (6, 18) being provided for connection of the helical winding with the other of said two objects, each chain link (1, 12) being retained in engagement with neighbouring links in the  
15 same turn as well as adjacent chain links in neighbouring turns.

2. A method according to claim 1, c h a r a c - t e r i z e d in that a reversibly rotatable driving device (3, 4; 15, 26) is used, said device increasing  
20 by rotation in one direction of rotation the length of the spindle device during winding of the chain links (1, 12) in said helical winding and reduces, by rotation in the opposite direction of rotation, the length of the spindle device (5, 16) during unwinding of the  
25 chain links (1, 12) from said helical winding.

3. A method according to claim 2, c h a r a c - t e r i z e d in that said coupling member (6, 18) is connected with the first produced turn of the helical winding.

30 4. A method according to claim 2 or 3, c h a - r a c t e r i z e d in that two elongate spindle members (57, 58; 67, 68) are formed by winding-up individual coherent sets of chain links (59, 60) in two helical windings with opposite pitch directions (65,  
35 66), the winding guide means of said sets of chain



links being connected with one and the other of said two objects, respectively.

5. A method according to claim 3 and 4, c h a -  
r a c t e r i z e d in that the two helical windings  
5 (57, 58) have the same diameter and that coupling  
members (63, 64) connected with the first produced turn  
(61, 62) of each winding are connected with each other  
intermediate said two objects.

6. A method according to claim 2 and 4, c h a -  
10 r a c t e r i z e d in that one of said helical win-  
dings (67) are advanced inside the other (68) and have  
chain links provided with an external threading (69) to  
engage an internal threading (70) in the chain links of  
the other helical winding to enable each of said  
15 helical windings to function as a coupling member for  
the other helical winding.

7. A method according to claim 2 or 3, c h a -  
r a c t e r i z e d in that a single spindle device is  
formed by winding two separate sets of chain links (76,  
20 77) in alternating turns in the same helical winding,  
both sets of chain links (72, 73) being supplied to the  
same winding guide means.

8. A method according to any of claims 2 to 7,  
c h a r a c t e r i z e d by its use in a raising/  
25 lowering device for mutual height displacement of the  
two objects.

9. A method according to any of claims 2 to 7,  
c h a r a c t e r i z e d by its use as an operator  
device for opening and closing windows or doors, in  
30 which said two objects are constituted by a stationary  
frame structure and an openable sash structure.

10. A method according to any of claims 2 to 7,  
c h a r a c t e r i z e d by its use as a drilling  
instrument, said coupling member being connected with  
35 a drill or cutter head.

11. A method according to any of claims 2 to 7, characterized by its use for reversible mutual displacement of telescopically connected tube members.

5 12. An apparatus for carrying out the method according to any of the preceding claims, characterized in comprising, in connection with one of said two objects, a chain storage (10) with an elongate chain (11) of interlocking chain links (12), a guide  
10 means (13) for advancing the elongate chain (11), and a winding guide means (14) connected with the advancing guide means (13) for winding said helical winding (16), and comprising a guide (22) for engagement with a guide member (34) on the chain links (12), whereas a coupling  
15 member (18) is provided for connection of said helical winding (5) with the other of said two objects, a driving means (15, 26) being provided for axial advancement of the spindle device produced by the helical winding (5).

20 13. An apparatus according to claim 13, characterized in that said coupling member (6, 18) is connected with an end turn of the helical winding.

14. An apparatus according to claim 12 or 13,  
25 characterized in that the chain storage (10) comprises an elongate track connected with the advancing guide means (13) for receiving the chain (11) in its entire length.

15. An apparatus according to claim 12 or 13,  
30 characterized in that the chain storage is constituted of a winch connected with the advancing guide means, on which winch the elongate chain is wound.

16. An apparatus according to any of claims 12 to  
35 15, characterized in that the winding

guide means (14) comprises a substantially part-cylindrical wall (21), on the interior side of which said guide is designed as at least one thread-rib (22) with a predetermined pitch across part of the interior side of the wall (21), and that, in unfolded projection, the individual chain links (12) has substantially the shape of a parallelogram with a first pair of engagement means (43, 44) for connection with neighbouring chain links at a first pair of opposite sides (28, 29), the guide member engaging said guide being provided on the exterior side (32) of the chain links (12) as a track (34) adapted to receive said thread-rib (22, said track forming with the first pair of opposite sides (28, 29) an angle ( $\nu$ ) adapted to said pitch.

17. An apparatus according to claim 16, characterized in that the advancing guide means (13) comprises a substantially linear guide rail (20) for controlled advancement of the chain links (12) towards the winding guide means through engagement with engagement means (45) at an interior side (33) of the chain links (12) and a guide surface (19, 24) for the exterior side (32) of the chain links, which guide surface is connected substantially in a tangential plane with the interior side of the part-cylindrical wall (21) of the winding guide means, said guide surface (19, 24) having near its connection to said interior side at least one advancing guide member (25) for engagement with a second guide member (35) provided in the exterior side (32) of the chain links, in such a manner that the chain links (12) are introduced into the winding guide means (14) with an orifice (38) for said track orientated towards a first end (23) of said thread-rib (22), said orifice opening in the downstream side (28) of said first pair of opposite sides with respect to the direction of advancement.

18. An apparatus according to claim 17, c h a -  
r a c t e r i z e d in that the advancing guide member  
(25) comprises a member protruding from the advancing  
guide surface (24) and that the second guide member  
5 (35) comprises a second track provided in the exterior  
side of the chain links, said track ending in said pair  
of opposite sides (28, 29) in track orifices (36, 37)  
displaced in a direction parallel to said first pair of  
sides (28, 29), such that each chain link (12) is  
10 introduced into the winding guide means (14) with an  
axial displacement component.

19. An apparatus according to any of claims 16 to  
18, c h a r a c t e r i z e d in that the drive means  
comprises an advancing wheel (26), which is provided in  
15 a peripheral surface with a number of oblique teeth  
(27) having a predetermined second pitch directed  
opposite to the pitch of said thread-rib (22), said  
advancing wheel being journaled coaxially in the  
winding guide means (14) for engagement with a guide  
20 member (39) in an interior side (33) of the chain links  
(12) and being connected with a drive wheel (15)  
coupled to drive means via a transmission, said guide  
member (39) in the interior side of the chain links  
being designed as a helical track which on the interior  
25 side of said helical winding (16) forms a number of  
coherent helical tracks (42) with said second pitch for  
engagement with individual ones of the oblique teeth  
(27) of the advancing wheel (26).

20. An apparatus according to claim 18 or 19,  
30 c h a r a c t e r i z e d in that said engagement  
means (45) form part of a second pair of engagement  
means (45, 47) provided at said first pair of opposite  
sides (28, 29) and being brought into engagement with  
opposite means on neighbouring links in the same turn  
35 (17) by the winding of the chain links, to retain the

chain links (12) in their positions in said winding.

21. An apparatus according to claim 16, c h a r-  
a c t e r i z e d in that the first pair of engagement  
means for each chain link (12) comprises, at said first  
5 pair of opposite sides (28, 29) a hook-shaped hinge  
member (44) and a curved track (43) for receiving said  
hinge member (44), respectively.

22. An apparatus according to claim 20 and 21,  
c h a r a c t e r i z e d in that said engagement  
10 means for each chain link (12) is designed as a fork  
member (47) provided at a free edge of a wall portion  
defining said curved track (43) for engagement, on one  
hand, with said guide rail (20) in the advancing guide  
means (13) and, on the other hand, with a rib member  
15 (47) provided in an interior side of said hook-shaped  
hinge member (44) and forming together with said fork  
member (45) a second pair of co-operating engagement  
means, whereby said fork and rib members (45, 47) by  
engagement with a rib member (47) and a fork member  
20 (45), respectively, on each of respective neighbouring  
chain links prevent mutual displacement of neighbouring  
chain links in the same turn in the axial direction of  
the helical winding, the hook-shaped hinge member (44)  
being provided, on each side of said rib member (47),  
25 with abutment surfaces (48a, 48b) serving as stop for  
branches (45a) of said fork member (45) for retaining  
neighbouring chain links in a predetermined angular  
position in said turn.

23. An apparatus according to claim 22, c h a r-  
30 a c t e r i z e d in that said mutually engaging fork  
and rib members (45, 47) are positioned in such a way  
relative to one another that said curved tracks (43) on  
a chain link (12) are brought into engagement with  
hook-shaped hinge members (44) in chain links posi-  
35 tioned side by side in the same turn and a neighbouring

turn.

24. An apparatus according to any of claims 16 to 23, characterized in that the chain links (12) are provided, at said second pair of opposite 5 sides (30, 31), with further engagement means (49, 50), which at the winding of the chain links (12) in said helical winding (16) are brought into engagement with corresponding engagement means on adjacent chain links in neighbouring turns for retaining chain links posi- 10 tioned side by side in neighbouring turns in mutual abutment.

25. An apparatus according to claim 24, characterized in that said further engagement means comprises a track (49) in the exterior side (32) 15 of the chain link (12) and a rib member (50) along one side and the other, respectively, of said second pair of opposite sides (30, 31).

26. An apparatus according to any of claims 16 to 25, characterized in that the chain links 20 (12) are formed with a substantially circular curvature with said exterior side as a convex side and said interior side as a concave side and with a length different from an even fraction of a circle.

27. An apparatus according to claim 26, characterized in that the length of the chain 25 links (12) constitutes an odd fraction of a circle.

28. An apparatus according to claim 27, characterized in that the length of the chain links (12) constitutes a fifth of the peripheral length of 30 the interior wall side of the winding guide means (14).

29. An apparatus according to claim 13 and any of claims 16 to 28, characterized in that said coupling member (18) is designed as a substantially disc-shaped cover member with a substantially 35 circular edge surface (51), in which a guide member

(52) similar to said guide member (34) on the chain links (12) is provided for engagement with said guide (22) in the winding guide means (14), whereas the cover member is provided, on one side surface (53), with 5 protruding engagement means (54) for engagement with each their respective chain link (12) in the first turn (17) formed in the helical winding (16).

30. An apparatus according to any of claims 21 to 23 and claim 29, c h a r a c t e r i z e d in that 10 each of said protruding engagement means (54) is provided with a hook member (55) corresponding to the hook-shaped hinge member (44) on the chain links (12).

31. An apparatus according to claim 25 and claim 29 or 30, c h a r a c t e r i z e d in that each of 15 said protruding engagement means (54) is provided with a groove (56) for engaging said rib member (51) on each their respective chain link.

32. An apparatus according to claim 16, 17 or 18 and any of claims 29 to 31, c h a r a c t e r i z e d 20 in that said guide member on the edge surface (51) of the coupling member (18) comprises a track (52) for receiving said thread-rib (22) in the winding guide means.

33. An apparatus according to any of claims 12 to 25 32, c h a r a c t e r i z e d in that the chain links (12) are moulded from plastics material.

34. An apparatus according to any of claims 12 to 32, c h a r a c t e r i z e d in that the chain links (12) are made as cast or sintered metal bodies.

30 35. An apparatus according to any of claims 12 to 34, c h a r a c t e r i z e d in that the helical winding (5) formed by the winding of the chain links (1) is surrounded by a casing (8) of variable length.

36. An apparatus according to claim 35, c h a - 35 r a c t e r i z e d in that said casing is a bellows.

37. An apparatus according to any of claims 12 to 36, c h a r a c t e r i z e d in that a chain storage, advancing guide means and winding guide means are provided in connection with each of said two objects 5 for producing two elongate spindle members (57, 58; 67, 68) by winding-up of two helical windings with opposite pitch directions.

38. An apparatus according to claims 13 and 37, c h a r a c t e r i z e d in that the two helical 10 windings (57, 58) have the same diameter and that coupling members (63, 64) connected with the first produced turn (61, 62) of each winding are connected with each other intermediate said two objects.

39. An apparatus according to claim 19 and claim 15 37, c h a r a c t e r i z e d in that one of said helical windings (67) are advanced inside the other (68) and have chain links provided with an external threading (69) to engage an internal threading (70) formed by said helical track in the interior side of 20 the chain links of the other helical winding (68) to enable each of said helical windings to function as a coupling member for the other helical winding.

40. An apparatus according to any of claims 12 to 39, c h a r a c t e r i z e d in that a single spindle 25 device (75) is formed comprising a helical winding of alternating turns of chain links (76, 77) supplied from two separate sets of chain links.

41. An apparatus according to any of claims 12 to 40, c h a r a c t e r i z e d by its use in a raising/ 30 lowering device for mutual height displacement of the two objects.

42. An apparatus according to any of claims 12 to 40, c h a r a c t e r i z e d by its use as an operator device for opening and closing windows or doors, 35 in which said two objects are constituted by a station-



ary frame structure and an openable sash structure.

43. An apparatus according to any of claims 13 to  
40, c h a r a c t e r i z e d by its use as a drilling  
instrument, said coupling member being connected with  
5 a drill or cutter head.

44. An apparatus according to any of claims 12 to  
40, c h a r a c t e r i z e d by its use for revers-  
ible mutual displacement of telescopically connected  
tube members.

5

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15

20

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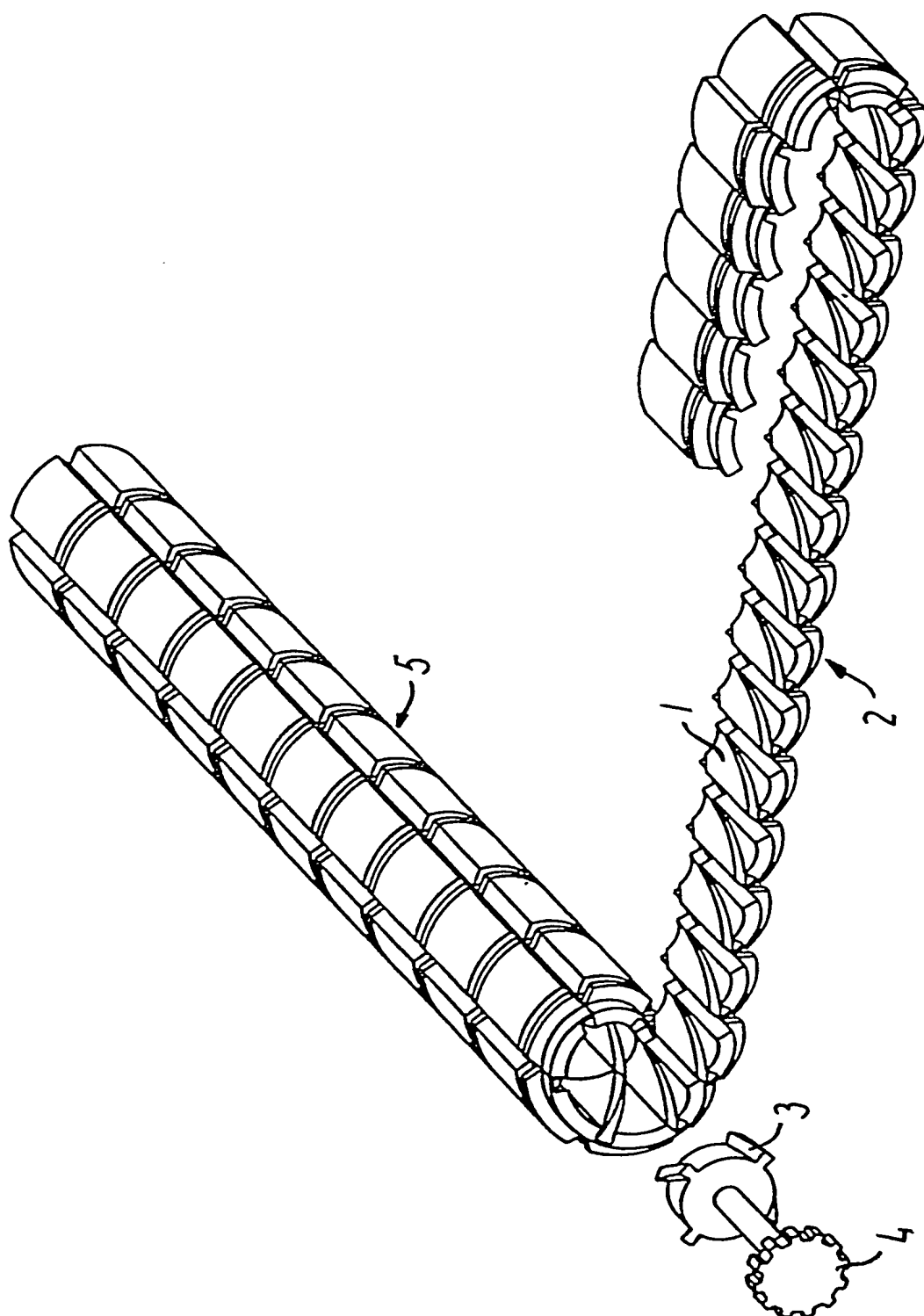


FIG. 1

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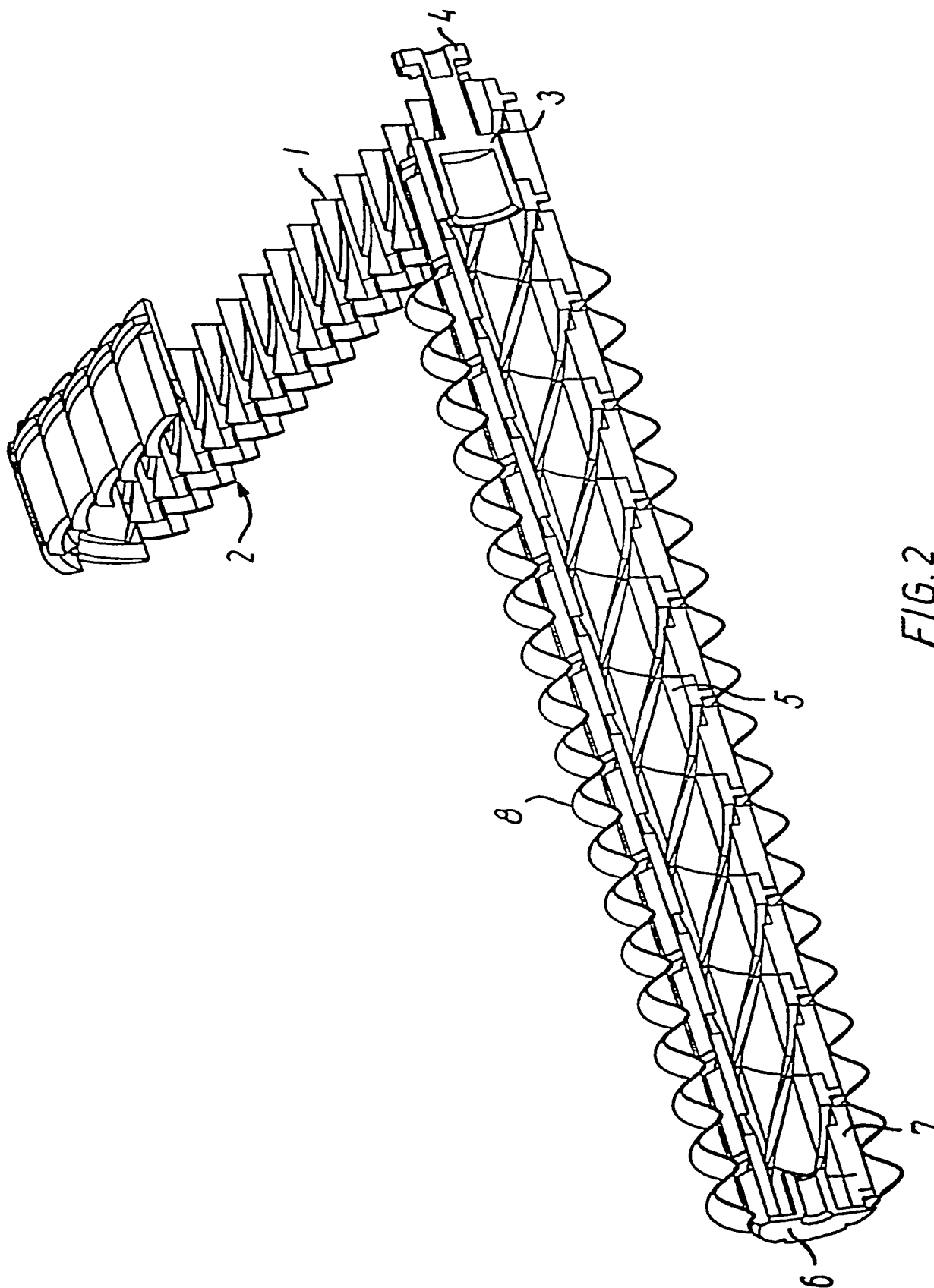
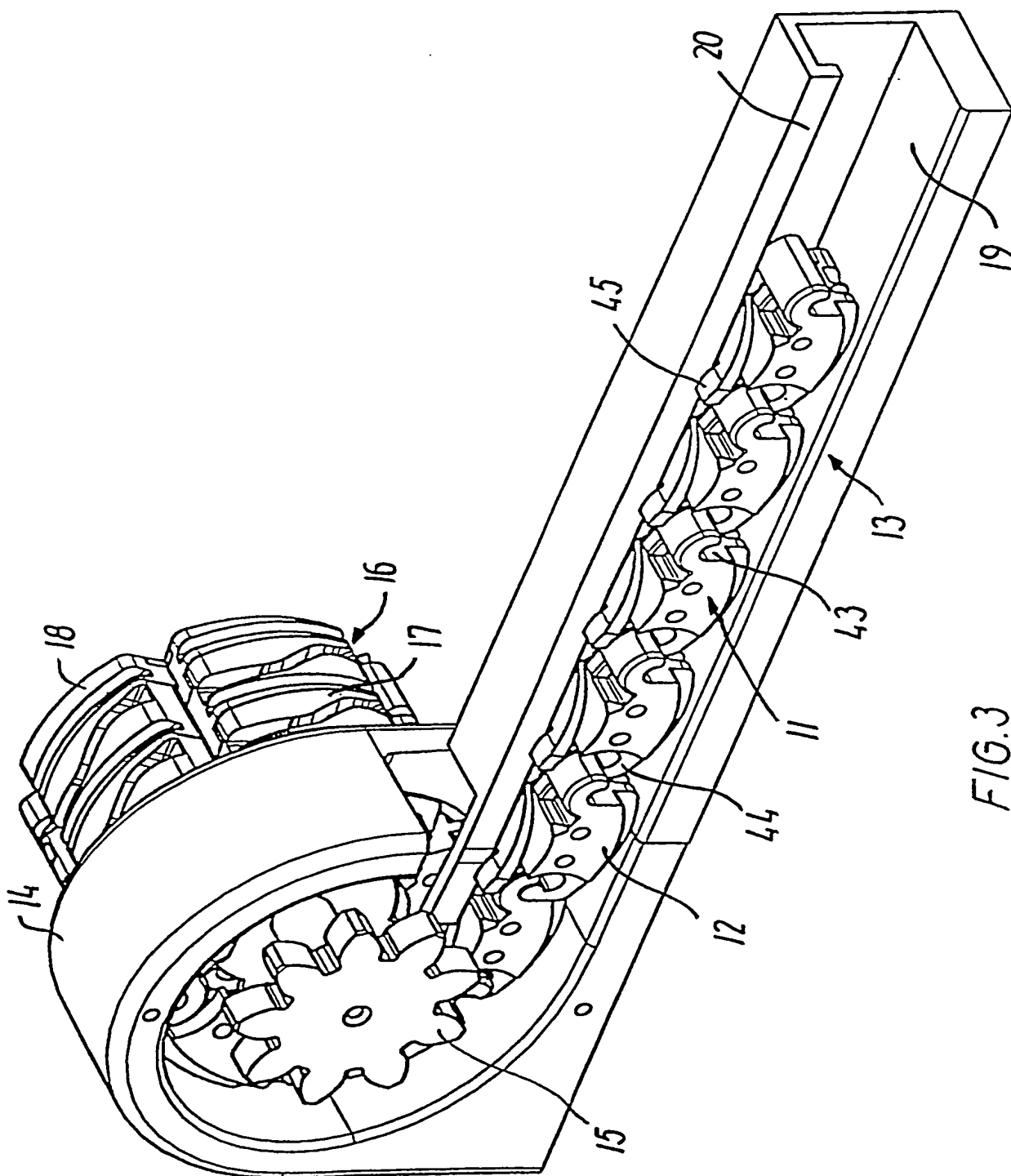


FIG. 2



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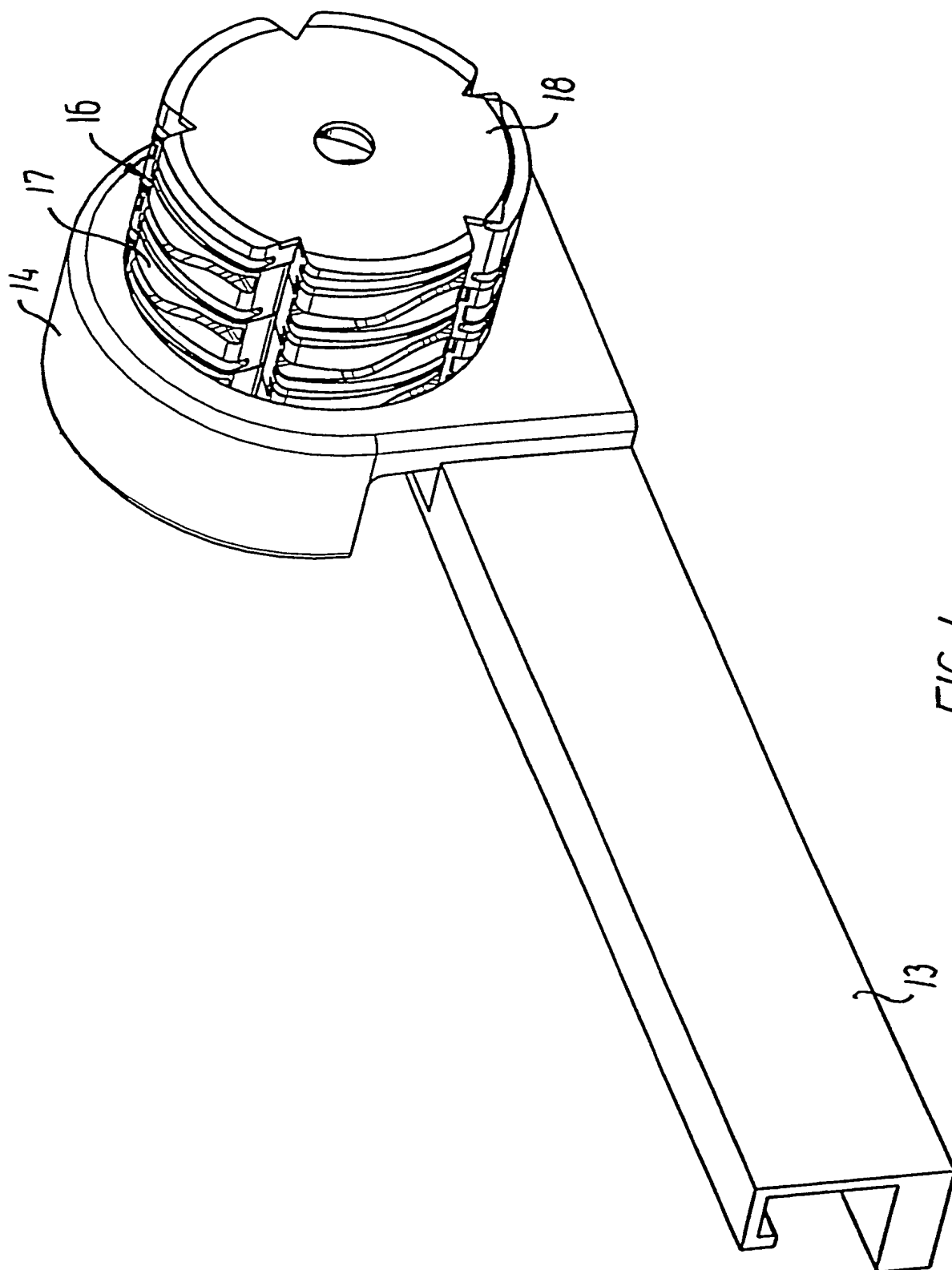


FIG. 4

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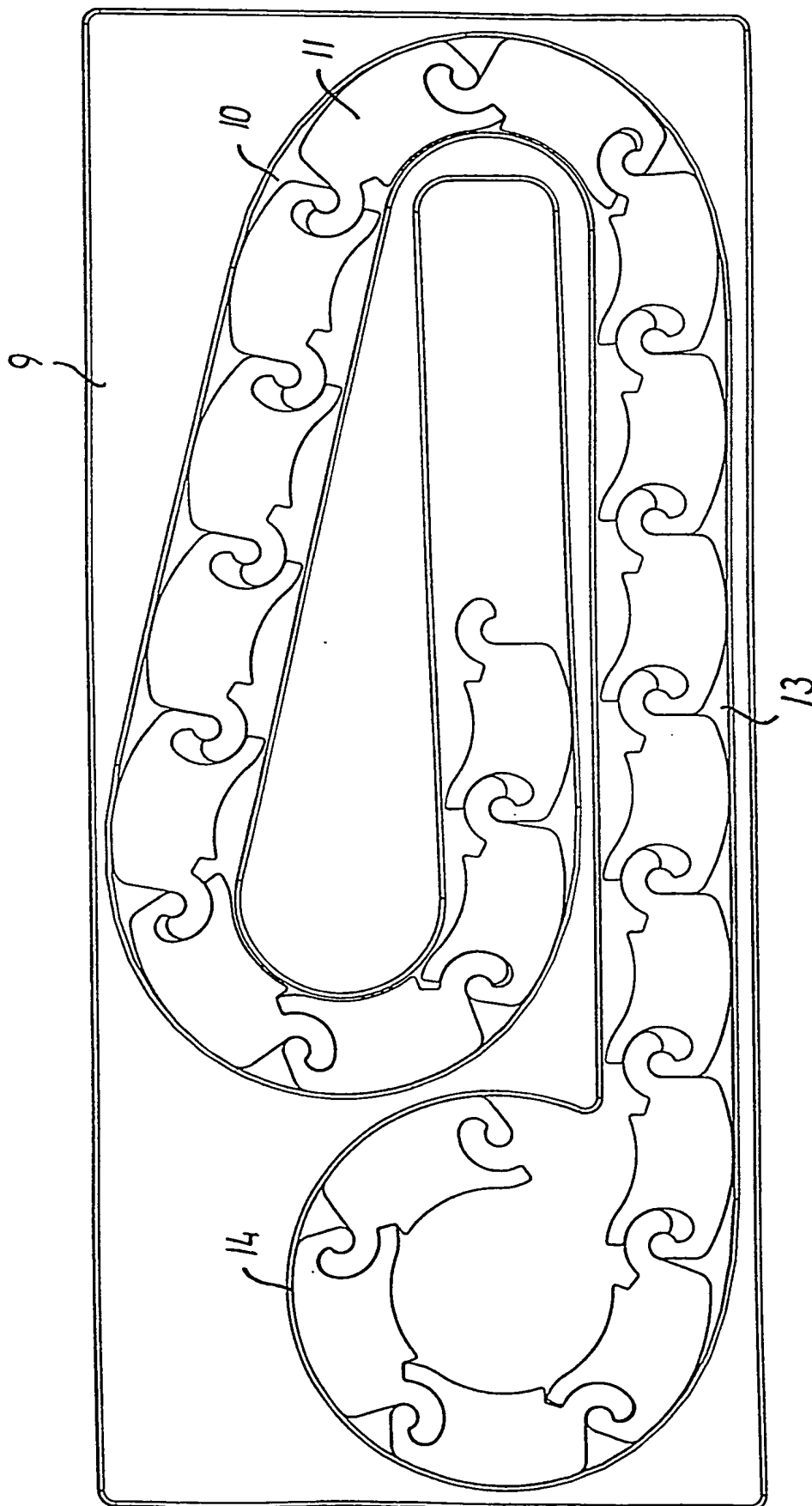


FIG. 5

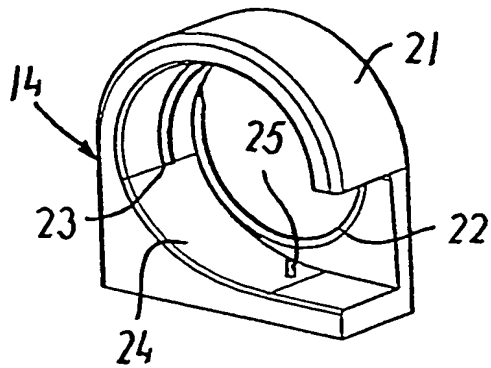


FIG. 6

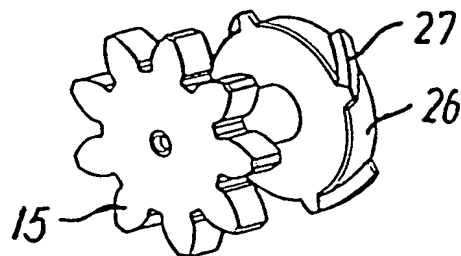


FIG. 7

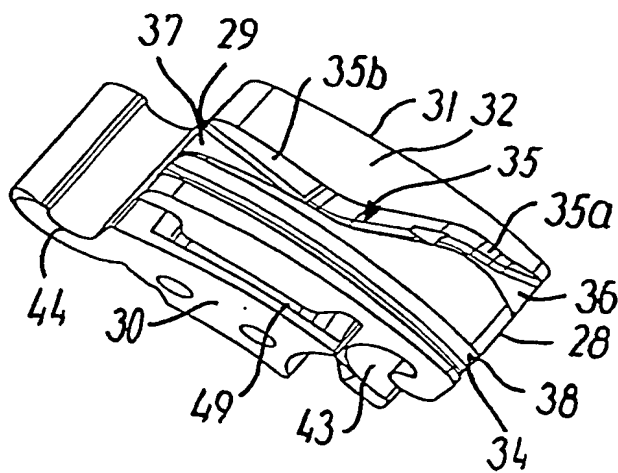


FIG. 8

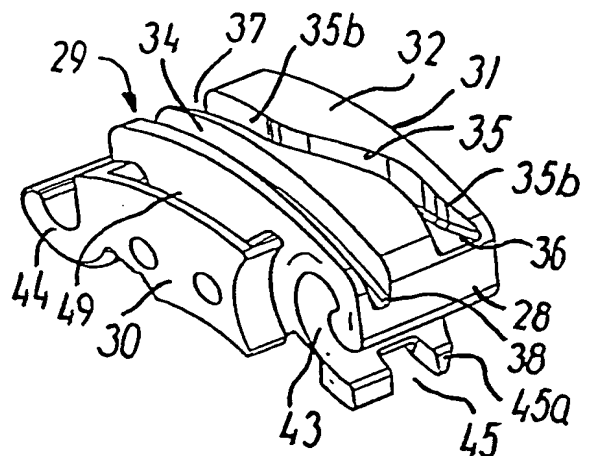


FIG. 9

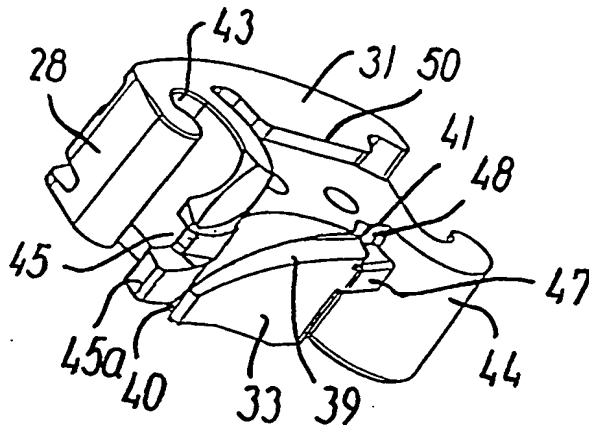


FIG. 10

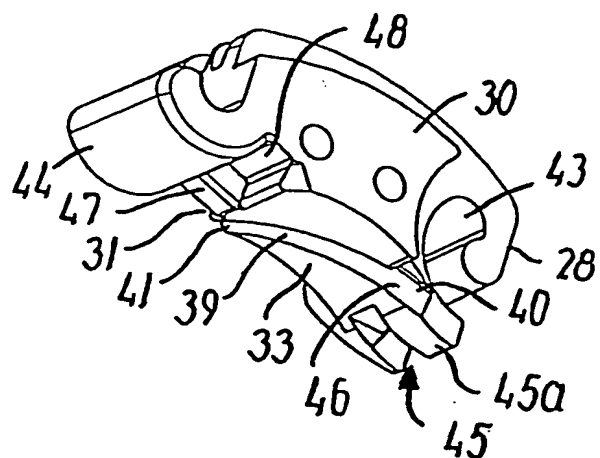


FIG. 11

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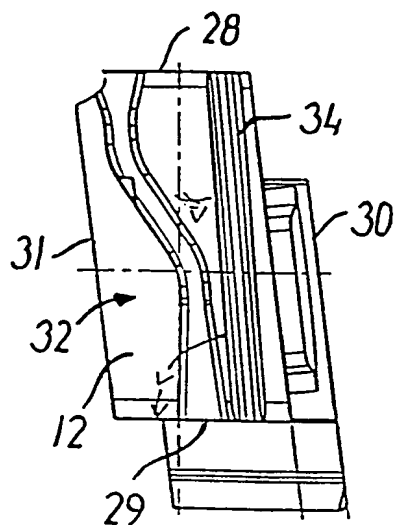


FIG. 12

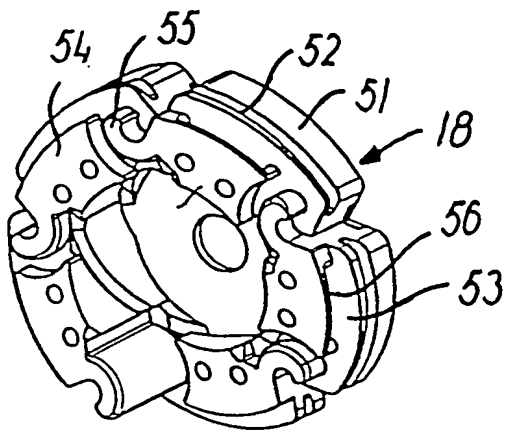


FIG. 13

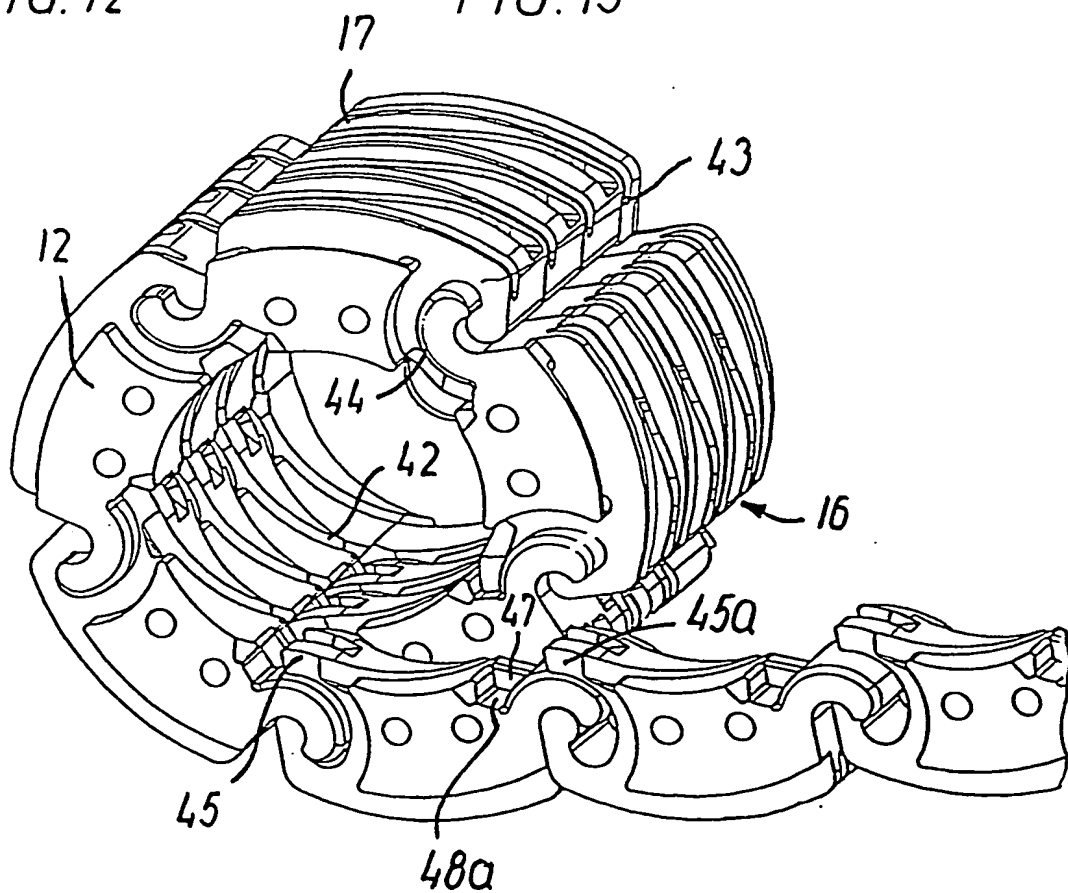


FIG. 14



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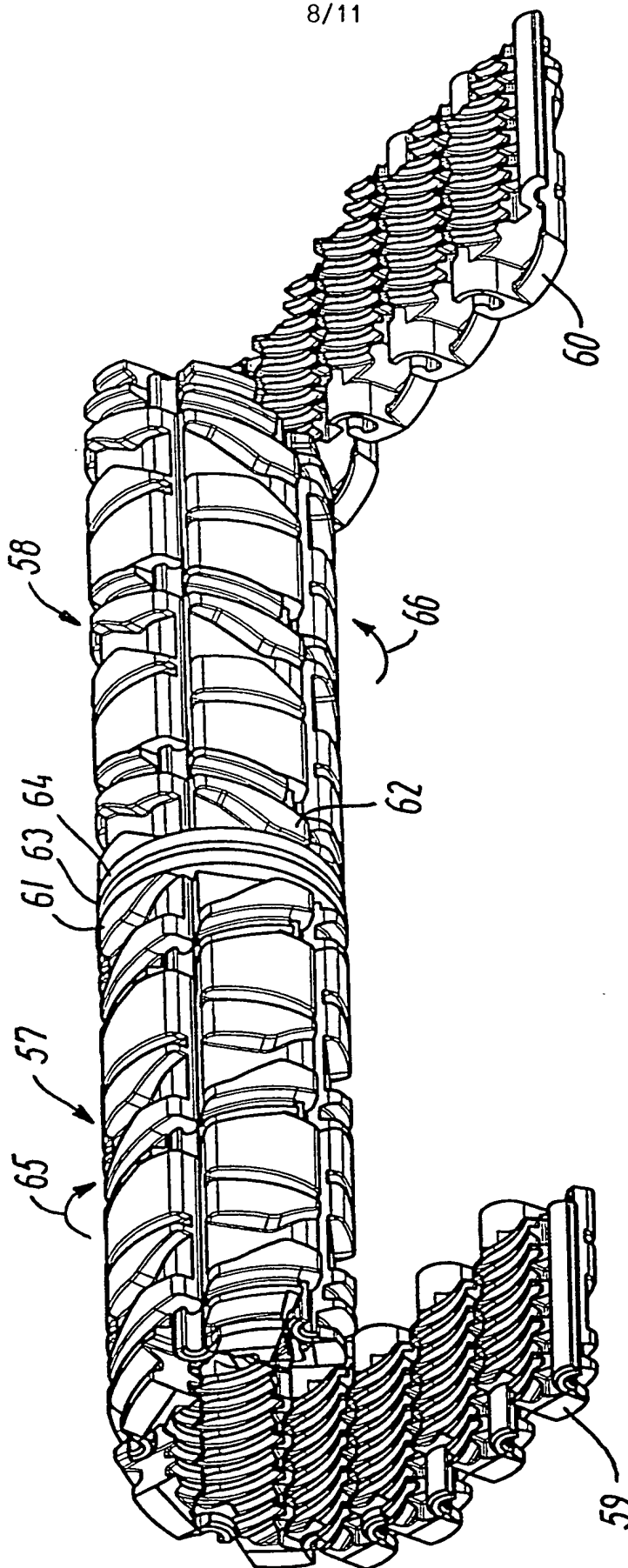


FIG. 15

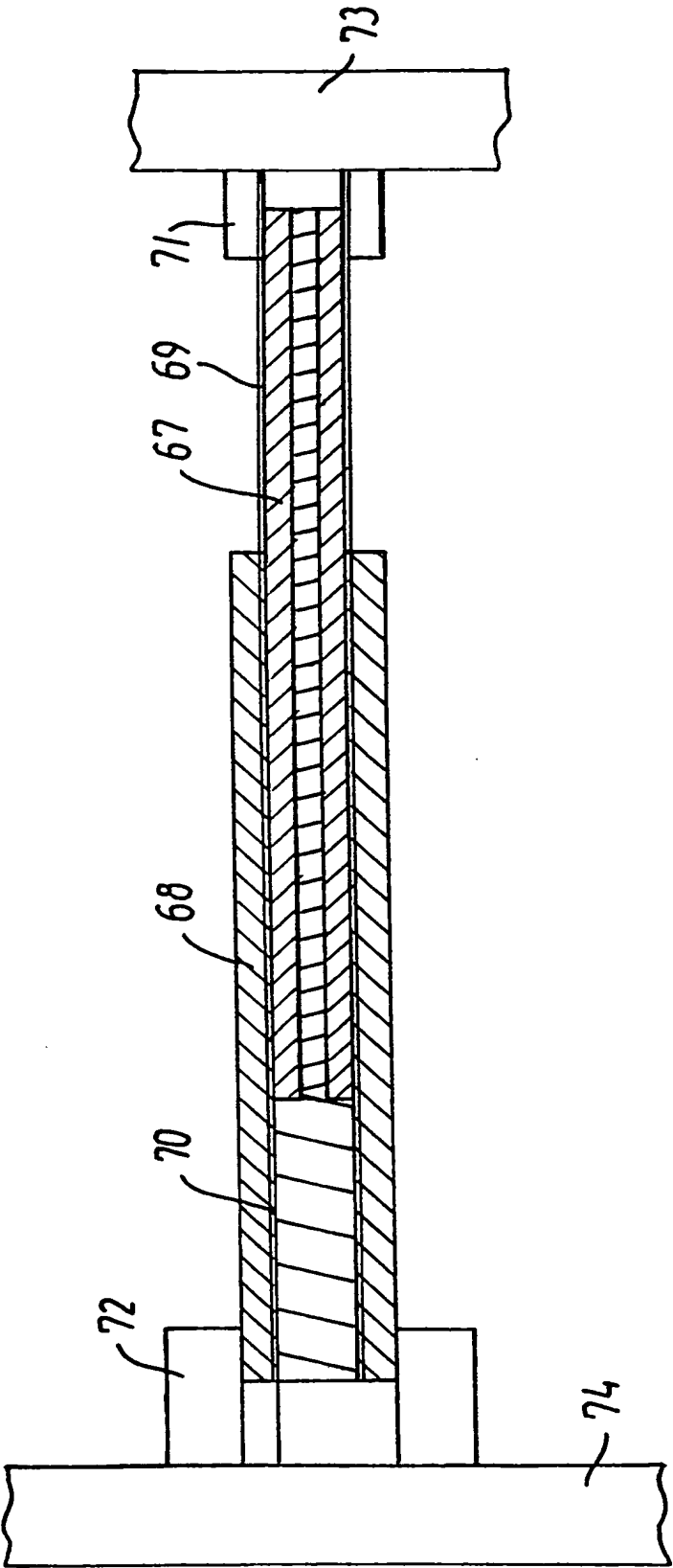


FIG. 16

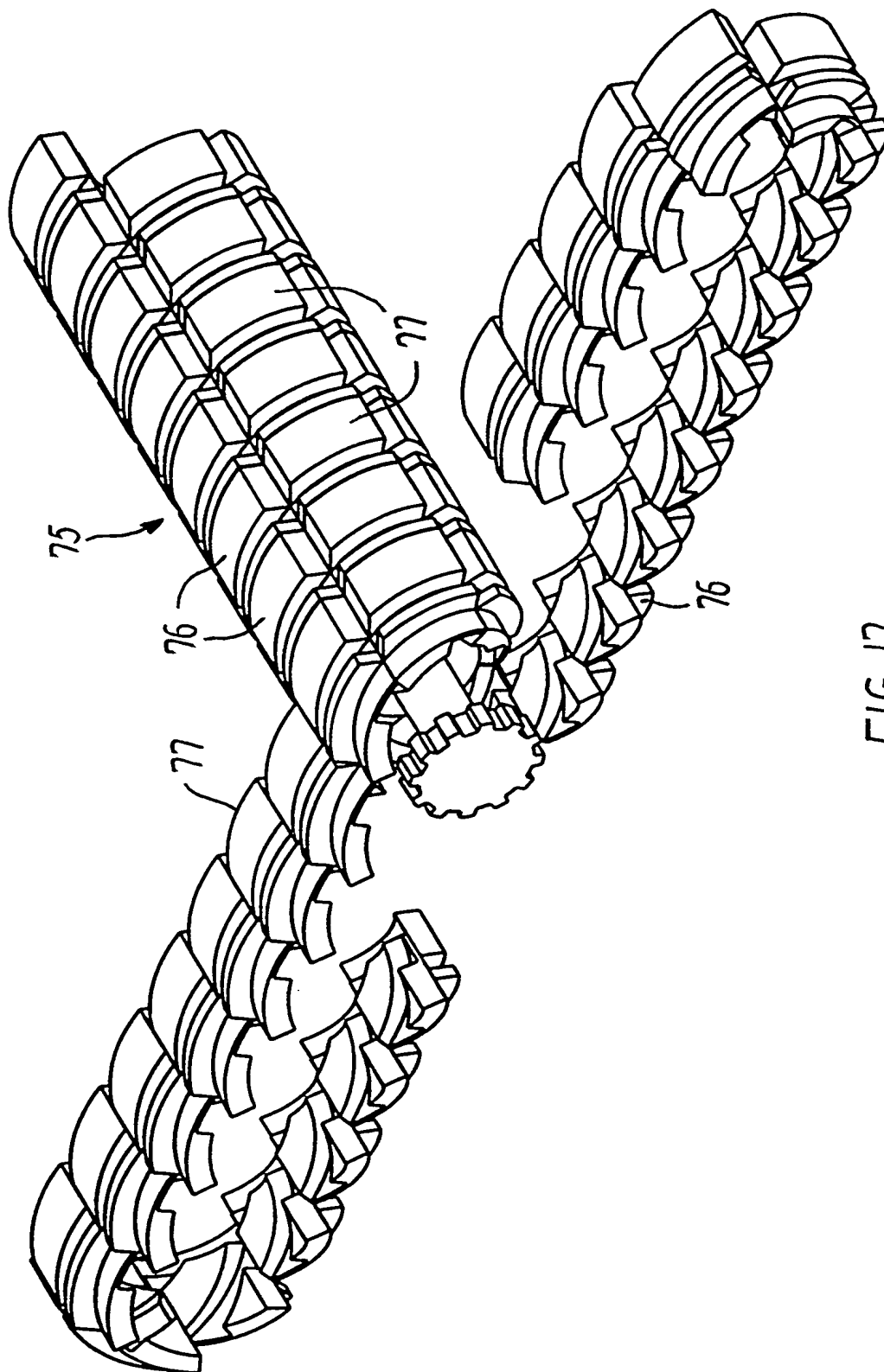


FIG. 17

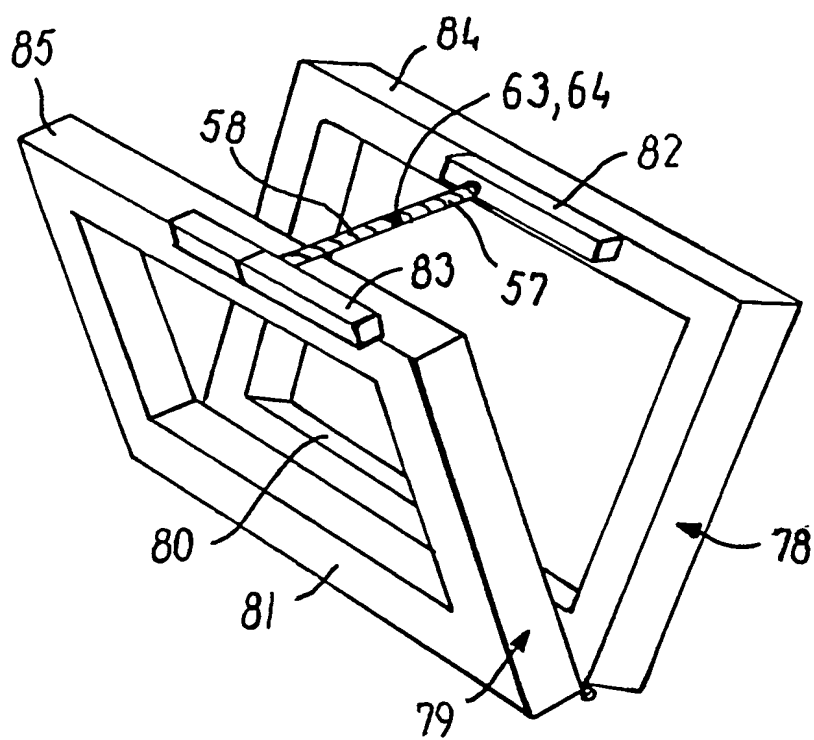


FIG. 18

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/DK 99/00171

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F16H19/00 F16H49/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 44 18 876 A (FLAMME KLAUS PETER DIPL ING) 18 January 1996 see the whole document ---	1,12
A	US 2 131 261 A (ALDEEN GEDOR W ET AL) 27 September 1938 see the whole document ---	1,12
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Further documents are listed in the continuation of box C.

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Patent family members are listed in annex.

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Date of the actual completion of the international search

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/DK 99/00171

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